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INVESTIGATION OF L'AMBIANCE PLAZA BUILDING COLLPASE[a]

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In describing their investigation of the collapse of L'Ambiance Plaza in Bridgeport, Conn., the authors of the paper introduce new and crucial evidence that, when combined with other information that has surfaced over the past four years, makes a compelling case for shear-head failure as the triggering mechanism at L'Ambiance Plaza. While we do not find fault with the evidence presented in the paper, our interpretation of that evidence leads us to a failure scenario that differs in certain important aspects from the scenario advanced by the authors.

Based on their assessment of wedge stability, the potential for large eccentricities of the X51 shear head on the stage IV column segments, the fact that a lateral load had been applied to plumb the west building, and clear evidence of an improperly installed wedge under the 12/roof slab package at column E3, the authors conclude that wedge roll-out and severe overstressing of the remaining wedge at this location constituted the trigger mechanism. According to their scenario, progression of the collapse involved the 12/roof slab package dropping onto the top of the 9/10/11 package at column E3 and ejection of the lifting nuts from under the shearhead at level 9 due to the resulting overload condition. The deformed shape of column E3 is taken as supporting evidence for this collapse scenario.

The authors present clear physical evidence that the column section identified in the National Bureau of Standards (NBS) investigation (Culver et al. 1987) as the top of column E4.8 is in fact the top of column E3.8. As a consequence, and most important, it follows that wedges were being installed at column E3.8 when the collapse occurred. McGuire (1992) has used this evidence of wedging operations to develop further his hypothesis that failure of the header bar-to-channel welds on the X51 shear head at level 9, column E3.8 triggered the collapse. This shear head is one of two shear heads in the level 9 slab identified in the NBS report as possible origins of the collapse. McGuire's hypothesis is given additional support by the transcript of a conversation between the surviving member of the wedging crew and a Texstar executive that became available in the course of Occupational Safety and Health Administration (OSHA) hearings held approximately two years after the collapse.

In McGuire's (1992) hypothesis, at least one of the wedges had been installed but not yet tack-welded. Cumulative damage to the bar-to-channel welds (one-sided square groove welds), combined with one wedge bearing only on the header bar, caused fracture of these welds and deformation of the header bar (N. S. Moreton Co. 1988). As the slab stack settled around column E3.8 due to partial loss of support, the lifting angles began to pick up load as they made contact with the lifting nuts. However, the torsional stiffness of the lifting angles was now compromised by the fractured welds

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and deformed header bar, allowing the lifting rods and nuts to be ejected from the rod slots in the shear head as described in the NBS report (Culver et al. 1987). The deeper nut tracks on one side of the rod slots are consistent with this scenario.

The failure scenario outlined by the authors is, in most respects, similar to one considered in the early stages of the NBS investigation. However, that scenario was discarded because of important inconsistencies with the deformed shapes of other columns in the west building, particularly those columns along column line C. In most instances, the stage IV segments of these columns were deformed in a characteristic "S" shape, a deformed shape that could result only from the tops of the C-line columns being laterally constrained in the north-south direction during the early stages of the collapse. In addition, the deformed shapes of the shear heads that remained on these columns and the "bite" marks they made on the column flanges as a result of slab rotation clearly indicate that the slab stack 12/roof remained in place and underwent no significant rotation while the floor slabs in the 9/10/11 package were failing. In particular, the top of column C3 shows no sign of the characteristic bite marks being made by either slab in the 12/roof package. Thus, the deformed shape and lack of bite marks at the top of column C3 indicate that both slabs in the 12/roof package were essentially undisturbed during the early stages of the collapse. In our opinion, this conclusion rules out a trigger mechanism under the 12/roof package at column E3 and supports McGuire's (1992) hypothesis of a trigger mechanism in the level 9 shear head at column E3.8.

The column section identified by NBS investigators as the top of column E4.8 was so identified primarily on the basis of a jack "footprint" caused by the jack rolling over due to an unbalanced load. The width of this footprint closely resembled the base of the smaller 667-kN (150-kip) jacks, one of which was installed on column E4.8, and was inconsistent with markings to be expected from the larger superjacks that were equipped with nominal 38 × 254 × 457 mm (1.5 × 10 × 18 in.) base plates. However, subsequent review of the numerous photographs taken during the investigation has revealed one superjack with detached base plate of width sufficiently narrow to have caused the observed indentation. As a result, we concur with the authors' identification of column tops at E3.8 and E4.8.

Clearly, there were many problems with L'Ambiance Plaza that contributed to the collapse. However, we are in agreement with the authors and with McGuire that failure at a wedge-supported shearhead triggered the collapse. As has been pointed out by McGuire, there were fundamental deficiencies in the design and fabrication of the shearheads; deficiencies that went beyond simple dimensional tolerances. This distinction is important in ensuring that more attention is given in the future to connection details, particularly in sensitive construction methods such as lift-slab construction.

APPENDIX. REFERENCES

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